POLLUTION PREVENTION IN THE LAND MAINTENANCE SYSTEM

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Abstract

This paper presents the implementation plan for the Sustainable Development Strategy in maintenance workshops serving the Canadian Land Forces. Workshop surveys were conducted during which opportunities for pollution prevention and impediments to positive changes were identified. Reducing sources of pollution was the primary goal but reducing costs and improving working conditions were also considered.

This initiative will reduce the amount of hazardous materials used and the amount of spent material, which must be disposed of as hazardous waste. Existing equipment is being audited and the requirement for use of high-risk consumables is being reviewed to eliminate or reduce their use. A material substitution program has made progress in lessening the dependence on high-risk products. The paper also discusses progress in developing and integrating the building blocks of an information system designed to track the consumption of hazardous materials and the generation of waste, to identify products containing targeted substances and to evaluate the relative hazards of products required to operate and maintain equipment.

Introduction

During the 1970s and 1980s control technologies were the primary means of combating pollution. This proved valuable for the environment as well as for the economy. It propelled rapid growth of an environmental technologies industry and its associated services. This approach focused on end-of-pipe solutions with little attention given to the origin of the pollution. However in recent years as progress from affordable pollution control technologies leveled off and further advances depended on a more fundamental approach, attention turned to the root causes of pollution.

In North America and elsewhere, environmental policies, guidelines and standards emerged that strongly promoted pollution prevention at source as it was considered to be the most effective means of protecting the environment, eliminating costly waste, and promoting sustainable development. As it became apparent that a purely ecological approach would not be sufficient to sustain the future of mankind, environmental protection was placed in a broader context, which considered economic and social factors. In Canada, a Sustainable Development Strategy that institutionalized pollution prevention across all federal activities was established.

Pollution prevention has been recognized as a major means of achieving sustainable defence activities and a key element of environmental stewardship. A Sustainable Development Strategy commits the Department of National Defence and the Canadian Forces (DND/CF) to limiting the impacts of defence activities on the environment and to contributing to the health and well being of Canadians while maintaining military operations.

Land maintenance system

DND/CF has an active operational presence in all regions of Canada including the Far North. The army, navy and airforce along with the many organizations which provide command and control, communications, maintenance and logistical support have at their disposal 20,000 km^2 of land, over 10,000

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individual facilities and more than 30,000 vehicles. Wherever these activities take place, the potential for affecting human and other natural environments exists.

Intrinsic to having a viable military land force is the maintenance of equipment used to support these forces. Providing this support requires the use of hazardous chemicals and practices, which are not always environmentally favourable. Maintenance activities can result in emissions of acidic and toxic air pollutants, liquid and solid waste pollutants, and greenhouse gases.

Canada's Land Maintenance System consists of first line field units, second line field units, base units and a repair and overhaul facility. The volume of work and age of facilities vary. Vehicle technicians, weapons technicians, fire control technicians and materials technicians at 121 maintenance shops spread across 13 bases provide operation and maintenance services. The workshops provide in-service maintenance to all land vehicles, weapons and equipment of the regular and reserve forces. Support is provided for systems ranging from armoured vehicles and aircraft ground support to small marine motors as well as land weapons, land tactical communication equipment, locks and safes, mechanical devices, electro-mechanical, and electronic equipment. The Canadian Forces vehicle/trailer fleet alone comprises over 20,000 individual vehicles and trailers.

Small workshops having less than 40 personnel are normally associated with first line maintenance units providing preventive and corrective maintenance and recovery activities. An example is a maintenance platoon in an infantry battalion supporting approximately 320 vehicles (fighting and administrative), mortars, crew-served and personal weapons, TOW systems, optical sighting and observing equipment, etc.

Medium workshops employing 40 to 100 persons are typically static workshops in support of small bases or stations. Maintenance support includes preventive and corrective maintenance as well as the replacement of major assemblies. Support to the supply system is also generously provided. Equipment support includes base/station vehicles, weapons, video equipment, etc. The number of each equipment type varies widely from one establishment to the next.

Large workshops having over 100 persons are normally associated with second, third and fourth line units. Large workshops provide corrective maintenance and rebuild or overhaul of assemblies and/or equipment.

Pollution sources

The activities conducted at these facilities consume a large variety of hazardous materials when cleaning and degreasing equipment prior to repair or painting, and for preservation or de-preservation of equipment. Environmentally, the petroleum, oil and lubricant products used in maintenance activities are of greatest concern. These activities generate a large variety of waste products such as oils, engine coolants, hydraulic fluids, chemicals, and waste metals including batteries. Within the workshops, the highest volume source of pollutants resides in the petroleum, oil, and lubricant and related product area. Within this category fuels such as diesel, gasoline, naphtha, and kerosene constitute the largest volume of hazardous products used by the land forces.

The origin of much of the pollution at DND/CF installations is beyond the control of the installation itself. Many of the workshop processes that generate pollution and wastes are the result of the design, operation and maintenance of weapon systems such as armoured vehicles. However, pollution avoidance is most effective when it is pursued early in the design stage. Introducing it as an afterthought at more advanced stages of project development limits the options and reduces the opportunities for success. Attention must be given to the reduction or elimination of pollutants during all phases of the life cycle of weapon systems, their subsystems and support systems.

Pollution Prevention Mechanisms

Reducing the requirement for hazardous materials needed to operate and/or maintain equipment requires careful foresight to implement planned pollution avoidance during the weapon system or equipment design stage. Life cycle analysis during the planning stage can identify opportunities to eliminate or reduce the requirement for hazardous materials that pose environmental risks during the operation or maintenance of the weapon system.

Within the Land element, an environmental assessment is routinely conducted on all new weapon systems and major capital equipment items. A similar process has been initiated for minor capital equipment items to ensure that all acquisitions are considered. An analysis of the hazardous materials required to operate or maintain the equipment or system forms part of the assessment. This process makes environmental impact an integral part of the evaluation of options along with cost, performance, and schedule.

Equipment review

The workshops are required to use prescribed products and processes when carrying out their maintenance functions. It is these prescribed processes and products that produce pollutants either through emissions or spills. Opportunities to prevent or reduce pollution during the in-service stage are being identified.

For existing weapon systems and equipment, a process has been initiated where specifications and standards that stipulate the use of hazardous materials in the operation, maintenance and repair of the system are systematically reviewed. The goal of the review of specifications, standards and technical orders is to reduce the requirement to use toxic chemicals and other hazardous materials or to replace these substances with less hazardous products.

A portfolio is being developed for each equipment and weapon system. The portfolio identifies materials that may pose a hazard to human health, the environment or to the equipment itself and encompasses all materials inherent to the equipment as well as those products that are required in its use and its maintenance. The content of technical orders, technical manuals, technical drawings was augmented through discussions with equipment managers to incorporate any changes which have not been documented. Information on the hazard sources - for example PCBs, radioactive active sources, mineral fibres such as asbestos and coatings, POL products and cleaners and degreasers were identified. To facilitate replacement of undesirable products with less hazardous items, information on substrate composition was gathered.

The portfolio includes an analysis of all the hazards associated with the equipment and recommendations for changes in maintenance products and procedures and in maintenance schedules. The updated maintenance manuals will have a direct impact on pollution avoidance in the workshops. For example, extending maintenance schedules, using extended life products and using dehumidification for preservation of equipment will lower the volume of hazardous products used and disposed of as hazardous waste and will provide cost savings.

Procurement of consumable products used in workshops

As with many other countries, Canada has lists of substances, which are regulated or targeted for elimination. These include ozone depleting substances and substances that are highly toxic, which bioaccumulate and which persist in the environment.

Consumable products used in the maintenance or operation of land equipment are reviewed to ensure that they:

- Generate fewer polluting by-products and/or environmental hazards during use and disposal compared to competing goods and services;
- Contain maximum level reusable, recycled and/or recyclable content to reduce post-consumer waste, without significantly affecting the intended use of the goods or services;
- Are available competitively, for a reasonable price and for delivery within a reasonable time period; and
- Do not contain substances that are targeted for reduction or elimination.

This process adequately controls products that are acquired nationally. One area that is problematic to all workshops is the control of hazardous materials obtained through local (Base and Unit) purchases. Most workshops have storage lockers filled with an assortment of hazardous and relatively non-hazardous products that are neither catalogued nor documented within the section or workshop. Although these products are commercially available, methods and procedures to assess, document or locally control their proliferation have not been consistently implemented across all units and bases. To facilitate implementation the building blocks of a national information system are being integrated and will be made available to all bases and units. One of these building blocks is a module, which provides an assessment of the relative hazards of new products relative to other products in the catalogue and identifies any ingredients, which are regulated or controlled.

Workshop audits

A baseline survey of maintenance practices was conducted at five representative land maintenance workshops. Maintenance facilities on navy, army and airforce bases were visited to look at all lines and levels of maintenance within the land maintenance system. In addition, visits were made to selected private sector maintenance workshops for comparison. The site visits were conducted during the period December 1997 and September 1998. Electrical Mechanical Engineering Workshops visited the included units from all lines and elements:

- A first line field unit,
- A second line field unit,
- A CAS base unit,
- A CMS base unit,
- A repair and overhaul unit
- A general maintenance Support unit,
- A Close support Group, and
- Four commercial maintenance facilities.

The results of the surveys formed the basis for questionnaires, which were sent to the remaining Electrical Mechanical Engineering Workshops. A good awareness of the importance of good environmental practices was found at all workshops with many good practices already implemented.

The level of waste segregation and reclamation was found to be directly related to the mobility of the maintenance organization. First line and Close Support Group units require low cost, simple practices to meet their mobile and tactical requirements. The use of absorbent pads appears to be the most versatile and cost effective means of implementing field pollution prevention measures for highly mobile units. The lack of vehicle carriage space frequently results in the commingling of waste POL streams (e.g., oils an antifreeze) thereby diminishing recycling opportunities and increasing hazardous waste disposal volumes and costs. Other wastes that are typically segregated in static operations (e.g., filters) my also be inadvertently directed to dry waste streams, improperly disposing of the product and increasing landfill waste volumes.

The visited units all possessed a high degree of spill response capability. However, field deployments pose a problem for spill control at petroleum, oil and lubricant (POL) points – whether at a unit's POL point or at tentline. The mix of barrel's, rough terrain and adverse weather conditions, combine to make operations and static pollution prevention means (e.g., spill pallets) difficult or impractical to implement.

Commercial benchmarking
Site visits were conducted at five external maintenance facilities which ranged from small mixed fleets to heavy production facilities. This provided a broad view of how common tasks were conducted within organizations of different sizes and complexity of organizational structure. In general, separate environmental committees were not found and environmental compliance was typically achieved through corporate environmental audits. In large maintenance facilities, formalized corporate programs were well established and responsibilities assigned. The use of a contracted agency to provide chemical management services for all non-production materials was a recent addition to one facility's environmental program. At this facility contractors were required to sign a copy of the firms environmental and safety policy before being allowed to work on-site.

There was little metal segregation at the external facilities. Bulk POL product dispensing and waste product tanks were used at all visited external facilities. Solvent bath servicing and solvent replacement was a contracted service at the visited facilities. This was found to be more convenient rather than an environmental requirement and bath units were not equipped with fume hoods or spill control devices. At the commercial facilities the effect of detergents on the effectiveness of oil-water separators was not a concern and where wastewater treatment plants were in place, they were assumed to be failsafe.

Best Practices

From the site visits and a review of alternative practices proposed by the US military and the US Centre for Hazardous Materials Research, over 40 best practices have been developed for Land Maintenance workshops to consider for implementation. The recommended practices will contribute to the implementation of the sustainable Development Strategy through sustainable maintenance activities.

Best practices have been categorized by workshop size, workshop type and implementation priority. The identification and evaluation of best practices is ongoing and the list will be updated periodically. A matrix of workshop versus best practices has been constructed and will be updated as part of the process to monitor progress toward meeting sustainable development goals.

Impediments

Some of the difficulties found in implementing pollution prevention initiatives could be attributed to:

- Lack of continuity of personnel. Military technicians are posted every two to four years. The person posted in may not be familiar with the equipment or procedures;
- The age of the facility. Where newly constructed or renovated facilities have been constructed around maintenance activities, the greatest gains in pollution prevention have been observed. Conversely old run-down facilities suffer from poor housekeeping and less stringent environmental practices.
- Lack of carriage space frequently results in mixing of POL streams (e.g., oils and anti-freeze) diminishing recycling opportunities and increasing hazardous waste disposal volumes and costs;
- Workshops bear the full cost of implementing new processes/equipment but any cost savings do not return to the workshop;
- Follow-up training is the use of new equipment such as reclamation and recycling units, HVLP paint guns etc.; and
- Lack of information on products.

Information system

Central to pollution avoidance is readily available information. Departmental policy specifies information of hazardous materials will be available to all stakeholders through one information system. Most of the required information already exists but is scattered in a number of electronic systems. Amalgamation of these systems is underway. The completed system will contain cataloguing information on the products (NATO Stock Numbers, part numbers, suppliers, prices), Material Safety Data Sheets, storage and shipping requirements, inventory data, disposal data, lists of alternate products, compatibility data of products with the materials they are used on, product selection tools, and relative hazard risks of products based upon readily available environmental, health and safety criteria.

Summary

Environmental concerns compete with operational tasks for resources. Although Canadian Forces and Land Maintenance System operational tasks have never been more demanding than in the recent past, significant progress has been made by workshops toward meeting Sustainable Development goals. Automotive coolant recycling is present in most workshops and alternatives to hazardous or polluting materials and processes are being sought at all organizational levels.

To conform to best environmental practices our maintenance workshops are working toward:

- Reducing hazardous solids and liquid waste generated by daily maintenance activities by reducing the amount of product used to the minimum required for maintenance activities and reusing and recycling products;
- Replacing or modifying processes which result in an environmental burden;
- Replacing hazardous materials with the least harmful product which will get the job done; and
- Optimizing maintenance routines and schedules to reduce fuel consumption and probability of emissions and leaks.